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Investigating the integration of everyday phenomena and practical work in physics teaching in Vietnamese high schools

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Making science relevant in students' learning is an important aspect of science education. This involves the ability to draw in examples from daily contexts to begin with the learning or to apply concepts learnt into familiar everyday phenomena that students observe and experience around them. Another important aspect of science education is the integration of practical work in students' learning. Both these aspects of learning actively engage students in their own construction of understanding and are particularly relevant in physics education where many of the concepts are abstract and are generally found to be difficult. This paper investigates the extent to which physics teachers in Vietnam integrate practical work and context-based approaches into their teaching, and explores the how, what, and why they do it. The findings indicate that the Vietnamese teachers value the benefits of both practical work and contextual approaches to teaching and learning physics, but the environment that they are in does not provide sufficient opportunities to implement these methods of teaching.

Vietnamese high school physics teachers, constructivism, learning using contexts, practical work

INTRODUCTION

General education in Vietnam is made up of primary and secondary education with the secondary component divided into basic secondary education (Years 6-9) and general secondary education (Years 10-12). The National Assembly of the Socialist Republic of Vietnam (1998) stipulated in Vietnam's Education Law that a requirement for the method of general education is to:

> …consist in developing the activeness, voluntariness, initiative and creativeness of the pupils in conformity with the characteristics of each form and subject, fostering the method of self teaching, training their ability to apply knowledge to practice, and impact on the sentiments, bring joy and enthusiasm in studies for the pupils.

The statement indicates that the focus in education at the school level is the developing of students' creativity as well as active and independent thinking, and the teaching of skills that will enable students to apply knowledge gained to practical situations. In their learning, it is desirable that students are motivated and enjoy the learning.

In the last twenty years, the Vietnamese education system has undergone much reorganisation and reform. These reforms have ranged from curricula and pedagogical redesigning, textbook rewriting and the education management system restructuring. The reforms aimed at improving the quality of teaching and learning in schools where developing students' ability to apply

knowledge to real life situations are considered the main objectives of general education. These objectives have arisen in response to the demands of socio-economic developments and the rapid pace of scientific and technological development in the country. The VIII Congress of the Vietnamese Communist Party has stated that, on the basis of two strategic tasks of building socialism and defending the country, in the year 2020, Vietnam must basically become an industrialised country with modern technical infrastructure. To achieve this, industrialisation and modernisation need to be accelerated. In terms of production, there will be a shift from using mainly manual labour to using advanced technology and modern production tools and control systems. Therefore, training the future labour force with basic technological and practical skills in order to fulfill the government's visions of new modes of production is of top priority on the government's agenda. The practical skills we mean here, similar to those used in a science laboratory, are those 'life skills' that will enable a person to survive well in a workplace environment. Such skills include critical thinking and problem-solving skills, being able to work in teams and being able to take responsibility and initiatives for one's own work. Schools, especially high schools, play an important role in guiding the development of these skills in students, many of whom will enter the workforce upon completing their education in high schools. Science especially is well placed in helping with the development of many of these skills.

Despite the Vietnamese government having spent vast amounts of money on improving the quality of teaching and learning at the school levels, the outcomes achieved to date are somewhat insignificant. According to a recent report from the Vietnamese Ministry of Education and Training (2001), the current education system in Vietnam has basic weaknesses. These weaknesses are:

> The teaching, learning and assessments and evaluation are mainly for the purpose of driving learners to mechanical memory, paying little attention to training independent and creative thinking abilities and applying knowledge and skills into real life the majority of teachers still uses very old and out-of-date teaching and educational methods which are heavy on imparting knowledge and do not emphasize on training students the independent and creative thinking methods as well as right attitudes towards learning and life. The capacity of practical training for students is very weak. The curricula and textbooks are heavy on theory, insufficient in application knowledge and practical skills, inadequate in training thinking methodologies and do not make their active contributions to the formulation and development of necessary abilities for people in real life. General education graduates are usually confused when entering real life.

This 'out-dated', transmissive mode of teaching and students' mechanical and rote manner of learning have been traditional forms of teaching and learning for many years in the education system of the country. Government policies now imply more student-centred modes of delivering the curriculum, where student engagement and more active participation in learning need to take place. In many western education systems such as in Australia, New Zealand, the United States and United Kingdom, student-centred teaching and learning have been promoted for more than three decades. Student-centred learning has been brought about by research into how children learn and the formulation of the constructivist theory of learning as one of the effective means of learning science. This theory is discussed in the next section.

There are values, attitudes and skills inherent to science education that are useful for students to develop and adopt in preparing them for life beyond school, and for a lifetime of participation in society. Science education fosters thinking and communicative skills. It promotes reinforcement of general social values – science questions our understanding of the world and ourselves, and systematically applies a set of highly regarded human values such as integrity, diligence, fairness,

curiosity, openness to new ideas, skepticism and imagination to seeking answers to these questions. Science lends itself to creative thinking which is characterised by fluency, flexibility, originality of ideas, openness to experience, courage, and imagination. Science is seen as a subject that stimulates students' curiosity and enquiring minds, and requires students to solve problems. The practical (experimental) nature of the subject fosters teamwork and manipulative skills of objects as well as promoting observational, deductive and evaluative skills. These are skills that sit well within the Vietnamese government's vision of training the future workforce to be comprised of creative and independent people. The fact that science is about learning about the real world and how things work within it means that science teachers are expected to teach students knowledge that they can apply to real life situations. Hence it is not surprising that policy makers put much of the blame on teachers, especially science teachers, for the lack of creativity and practical skills in students. There has been little research conducted in Vietnam to investigate the ways science teachers deliver their lessons to high schools students, their perceptions of the type of science teaching and learning that is beneficial for students' learning, and the issues faced by them in their delivering of the teaching. The aim of this research study is to begin the exploration of one aspect of physics teachers' beliefs and practices in the teaching of physics in secondary classrooms: the integration of everyday phenomena and practical work into their teaching. While there are many strategies that can be incorporated into physics teaching that are deemed effective for learning, these two teaching strategies are the focus for this study due to their explicit identification in the Vietnamese Education Law. The research questions are:

1. To what extent do physics teachers in Vietnamese high schools integrate everyday phenomena and practical work into their teaching?
2. What are their perceptions of the importance of these integrations?
3. How, if they do, do physics teachers bring about this integration?
4. What are the issues, if any, of integrating everyday phenomena in their teaching and incorporating practical work into students' learning?

In the next section we present the theoretical framework underpinning this investigative study. In order to critique different methods of teaching science, such as the use of a contextual approach and practical work in this study, the aims of science education at the school level are discussed first. This is followed by a discussion of the contextual approach to learning where study of concepts are related to real-life everyday situations, and the role of practical work in science learning. The benefits and drawbacks of each is discussed, with emphasis on physics teaching and learning.

THEORETICAL FRAMEWORK UNDERPINNING THIS STUDY

Aims of science education

Millar (2004, p.1) in his article on *The role of practical work in the teaching and learning of science* summed up broadly two main aims of science education:

- To help students gain an understanding of as much of the established body of scientific knowledge as is appropriate to their needs, interests and capacities
- To develop students' understanding of the methods by which this knowledge has been gained and our grounds for confidence in it (knowledge *about* science).

The first aim is about understanding the content of science and the second is about understanding the nature of science. An understanding of how science and the scientific community work will help students learn the content of science better. This includes understanding of the processes

involved in the conducting of a scientific enquiry, the intellectual reasoning used by scientists to analyse data and produce evidence in order to make a claim or propose a theory, and how this evidence is verified by the scientific community,

Most schools across the globe have science as a compulsory subject in high schools. Why is it necessary for all students to have basic content knowledge about science or to have an understanding of the nature of science? A socio-economic argument by governments, as in the vision of the Vietnamese government, is that science and technology research and development will bring health to the nation's people and wealth to the nation economy. Creating a 'clever' country where the training of future scientists and engineers begins in the classroom is worth investing in. A more inclusive argument would be the importance of fostering 'science literacy' in students, and the community at large, as a major purpose of science education.

Scientific literacy

The OECD/PISA[1] (2003, p.133) defines scientific literacy as:

> The capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity.

Similar assertions are made by the American Association for the Advancement of Science (1993) in Project 2061, Goodrum, Hackling and Rennie (2001), the National Research Council (1996) and Whittle and Maharjan (2000). Shen (1975) breaks the broad definition of scientific literacy into three components: practical, civic, and cultural. Science is an integral part of everyone's life, and science knowledge and skills provide practical assistance in helping people make informed decisions and choices of the way of life that are best suited for them. The civic aspect of Shen's scientific literacy enables citizens to be able to read and understand reports and articles in the media and to engage in social conversations about ethical and moral issues, for example issues about cloning, the use of nuclear energy and nano-technology research, and have influence over government decision making. The cultural aspect of science literacy emphasises the importance of learning about the nature of science in its social and human context.

Scientific literacy can have diverse and important roles in people's lives, and its values, inherent in the knowledge and processes of science, provides a strong justification for education in science. In preparing for a scientifically literate population, science education prepares for future scientists, engineers and technologists as well as a citizenship that has sufficient knowledge and understanding to enable them to think critically to make sensible decisions about science related matters that affect their lives. In addition, the skills developed from science learning are valued by employers across the board and provide opportunities for students for a broad range of careers apart from preparing them to be future scientists.

Teaching students to be scientifically literate

Disengagement with learning physics

To effectively achieve the goal of teaching all students to be scientifically literate, science curriculum design and approaches to its teaching need to cater for the diverse range of interests and capabilities in most school populations, and to help students to be more engaged with the learning of science. Disengagement of secondary school students in science learning is a problem in many countries. For example, in Vietnam the main method of teaching is often the transmissive mode where teachers read while students listen and write down mechanically word-by-word what

[1] Organisation fro Economic Co-operation and Development/Programme for International Student Assessment

is read. In Australia, student numbers enrolling in science subjects, particularly physics, in the final year of their secondary schooling are low in comparison to that of other subjects (Goodrum et al., 2001; O'Keefe, 1997). In the research report *The Status and Quality of Teaching and Learning of Science in Australian Schools*, prepared for the Department of Education, Training and Youth Affairs, Commonwealth of Australia, Goodrum et al. (2001) highlighted the high level of disengagement of Australian students in high school science as being associated with the lack of relevance in the science that they are taught. Karplus (1969, p.3) in his book *Introductory Physics* asserted that science, once a branch of philosophy, has been fragmented into discipline areas such as physics where it is no longer familiar to every educated person. He suggested four reasons for this: (i) people no longer see the need for formal studies of science, (ii) many of the questions addressed in the sciences, particularly physics seem detached from their everyday experiences, (iii) science often use indirect evidence to base conclusions, and (iv) people identify science with destructive weapons and technologies that threaten the environment that they are in. In today's society, these reasons are cause for the decline in science enrolment numbers at senior secondary and tertiary levels. The worldwide concern with declining numbers of students undertaking physics at senior secondary and introductory university courses has also been addressed by Hewitt (2004).

Physics teaching using contexts

The lack of relevancy in physics education has been an issue in many countries. In response to this, different projects and/or curriculum restructuring have been initiated. Most of these projects place emphasis on the everyday application of physics in students learning, that is, context-based learning (Wilkinson, 1999b). In his article *The contextual approach to teaching physics*, Wilkinson (1999b) reviewed the move of physics education towards context-based teaching and learning since the 1970s. The contextual approach to teaching places the learning of physics in real-life contexts where phenomena familiar to students' personal experiences are used as contexts for learning or otherwise incorporated as much as possible into the teachers' teaching. The approach further integrates the learning of science concepts with technological and social issues – the Science, Technology and Society (STS) approach to content. Such a framework has seen many initiatives (cited in Wilkinson, 1999b) developed, such as the Dutch PLON (a Dutch acronym for Physics Curriculum development Project) in 1972; the Canadian large context problem (LCP) approach in the 1980s; the Scottish applications-led approach in the late 1980s; the event-centred learning approach in Brazil and the United Kingdom in the early 1990s and more recently (1994-5) the Supported Learning in Physics Project in the United Kingdom Open University. In Australia, the Victorian Certificate of Education (VCE) 1992 physics course was developed using the context-based approach.

Wilkinson (1999b) outlines the benefits of learning through contexts to include (i) student motivation and engagement as a result of perceived relevant learning drawn from everyday real-life examples and phenomena and (ii) the development of critical thinking and problem-solving skills with questions centred around a familiar context would lead to more effective learning. He also discussed the drawbacks to this approach to learning citing Stinner's (1994, p. 49) findings that 'physics teachers often encountered problems when trying to incorporate large contextual settings, such as LCPs, into the conventional textbook-centred teaching of physics…' This is due to students' inability to deal with context generated problems 'unless they already have content knowledge' (Stinner, 1994, p.49). In dealing with contexts in their teaching, VCE physics teachers have also indicated that it 'took time away from teaching content' (Wilkinson 1999a, p.63).

Pedagogically, an important aspect of teaching through contexts is the fostering of active construction of knowledge by students (Fensham, 1996). The next section of this paper deals

briefly with the learning theory of constructivism and its significance in learning science effectively.

Teaching constructively

There is an enormous amount of literature on constructivism and education. Over the last thirty years, some 5000 scholarly articles on various aspects of constructivism and education (Matthews, 1998) have been published. Educational constructivism, as applied in many science classrooms, draws on both the cognitive and the social theories of Piaget (1955, 1972) and Vygotsky (1962, 1978) respectively.

Central to the constructivism learning theory is the belief that the learner is active in shaping how new knowledge is taken in and shaped and, furthermore, that new understandings emerge progressively as learners develop hypotheses, test those hypotheses and re-shape their understandings on the basis of experiences. It sees learning as a dynamic and social process where students bring into the classrooms strongly established views of the world, or prior understandings, which have been formed by years of experience. The construction of these views is a result of their own personal experiences in interacting with objects or phenomena around them or by being exposed to various sources of media. This prior knowledge, that learners possess influences their learning process, they are not passive recipients of knowledge and conceptual changes will result from their prior understandings being challenged and revised (de-constructing and re-constructing where necessary). The role of the teacher is to provide students with opportunities to be actively engaged in their own learning by ensuring that teaching is student-centred with opportunities for exploration, discussion, working in groups and problem solving. ‘Hands-on’ approaches are advocated in constructivist-based learning. By using contexts that incorporate real-life phenomena, students are provided with opportunities to review and assess their own world-views and be actively involved in the refining of the understandings held prior to the learning. In schools, the role of the teacher is to guide the construction of ‘new’ understandings and meanings closer to a body of knowledge that has been accepted in the scientific community.

Another constructivist learning strategy is the use of practical work in science teaching/learning. As the use of practical work in Vietnamese high schools is the focus of this study, its role in science learning is discussed in the next section.

The role of practical work in the teaching and learning of physics

For the rest of this paper, practical work is defined according to Millar (2004, p.2):

> any teaching and learning activity which involves at some point the students in observing or manipulating real objects and materials.

Practical work in this sense includes fieldwork, laboratory work and experimental work. In the context of our study with Vietnamese high school physics teachers, classroom teaching was the focus of our study but not fieldwork, and the wordings of ‘practical work’, ‘laboratory work’ and ‘experimental work’ are used interchangeably in this paper to have similar meanings in Millar’s context.

Tamir (1991) has established five major rationales for school science laboratory work. These are (i) laboratory work provides students with opportunities for understanding and manipulating the highly complex and abstract nature of science in inducing effective conceptual change, (ii) working with the actual investigations helps students develop procedural knowledge, promote problem-solving and analytical skills as well as fostering scientific attitudes and values such as honesty, patience, acknowledgment of failure, understanding experimental limitations and being

able to critically assess results, (iii) the development of skills, such as creative and critical thinking skills, which are essential for survival and success, (iv) laboratory work helps identify, diagnose, and remediate students' misconceptions, and (v) practical work motivates and interests students in science. These reasons were derived from Tamir's earlier work with Shulman (1973) where groups of objectives that could be achieved through the use of laboratory work in science classes were listed.

Advocates of the benefits of practical work in science and physics learning include Escobar, Hickman, Morse, and Preece (1992) who stated that the laboratory plays a central role in high school physics courses in providing experiences where testing will promote development of systemic reasoning and predictive ability in students. Millar (2004, p.7) has argued, based on the work of Jean Piaget and constructivism, that:

> We construct increasingly sophisticated and powerful representations of the world by acting on it in the light of our current understandings, and modifying these in the light of the data it generates. Through action on the world, we generate sensory data which can either be assimilated into existing schemas or require that these be changed to accommodate the new data, in order to re-establish equilibrium between the internal and external realities. Through such action, we construct a view of what objects these are in the world, what they are made of and what can be made from them, what they can do and what can be done to them.

Student laboratory activities should be designed to develop 'higher' cognitive skills that underpin scientific methods of working (Woolnough, 1991). However, research studies have shown that most practical tasks in science laboratory manuals are prescriptive, providing little or no opportunities for open-ended or enquiry-based learning and that practical work can be unproductive and little learning of science goes on with students in practical classes (Berry, Mulhall, Gunstone, and Loughran, 1999; Clackson and Wright, 1992; Harrison, Fisher, and Henderson, 1997).

Effective science practical work, including physics, need to consider the following:

- Students must be provided with opportunities to manipulate equipment and materials while working cooperatively with others in an environment in which they construct their scientific knowledge and engage in processes of investigation and enquiry (Tobin, 1990).
- The intended learning outcomes of doing the practical work must be made clear in students' minds so that students will not be confused with the complexity of the practical task while carrying it out (Millar, 2004).
- The practical tasks are well-designed and focus on certain and in depth topics to help students acquire and develop science concepts or frameworks of concepts (Hofstein and Lunneta, 2002).
- In order for learning to occur with practical work, students need to be given sufficient time to interact, reflect and discuss (Gunstone and Champagne, 1990).
- Students be taught how to take control of their own learning and provide opportunities for metacognitive activities, rather than concentrating on technical ones (Gunstone 1991).

Karplus (1969) asserts that a progression from exploratory activities to laboratory-type investigative activities is necessary for effective science learning. Based on the learning theory of Piaget, Karplus (1969), and Karplus and colleagues (1977) at the University of California, developed a three-stage cycle of learning that optimises effective learning in science. These stages involve (i) exploration stage which is based on students' experiences and they are challenged to make connections with their existing experiential background with the areas of study, (ii) concept

introduction stage where the teacher guides the students toward a model/theory which can be used to explain the observations made in the exploratory stage, and (iii) concept application stage where students undertake problem solving and laboratory investigation tasks, applying the knowledge in the second stage to new situations. Many teachers, however, focus only on the third stage and omitting the first two stages, which inevitably leads to the perception of physics being too difficult by students who will stay away from the subject.

METHOD

The instrument used in this exploratory study is a questionnaire constructed in an Australian university. The questionnaire is an adaptation of the questionnaire in *Labwork in Science Education*, published by the European Commision (EC) in 1998. The EC questionnaire was used to survey laboratory work carried out by high school physics teachers in several European countries. The questionnaire that this study is based on probed Vietnamese high school teachers' views on the integration of laboratory work, as well as the use of real life contexts in their physics instruction to years 10, 11 and 12 students. The seven-page questionnaire surveyed the teachers on the following categories: the frequencies of integrating everyday phenomena and practical work (demonstrations, and laboratory-based work), the reasons for the integrations, examples of integrations, and how the integrations were carried out. The questionnaire was reviewed and tested on two Vietnamese physics teachers studying at the Australian university.

The questionnaires and letters of invitation to participate were translated into Vietnamese and 20 questionnaires were mailed and distributed to physics teachers in seven Vietnamese high schools in the two central provinces of Vietnam – Nghe An and Ha Tinh. The socio-economic background of these two provinces is similar to those of the larger cities of Hanoi and Ho Chi Minh where living conditions are generally good. The quality of education in schools in these provinces is considered good in terms of the number of successful students progressing to tertiary education. Depending on the size of the school population, the schools typically have between two to four physics teachers whose sole job is to teach physics to senior secondary students. This is unlike the Victorian education system in Australia where specialist physics teachers almost always have to take general science classes at the junior secondary levels, and hence are required to teach biological and chemical sciences as well. All the questionnaires sent out to the Vietnamese teachers were returned. The teachers responded by filling in all the closed questions, but with varying degrees of gaps in the responses for the open type questions. The 100 per cent return is based on the assumption that teachers who did not want to fill in the questionnaire would pass it onto those who were willing to do so. In this regard, the sample might be slightly skewed. However, in the smaller schools, the entire cohort of physics teachers would have filled in the questionnaires, making the spread more even. The responses were translated into English for analysis.

RESULTS

Profile of physics teachers

The 20 physics teachers who participated in this study were evenly split in terms of gender, with 35 per cent of them having more than 10 years of teaching experience, as shown in Table 1. A majority of these teachers come from public schools and 30 per cent of these teachers have had education up to the Masters level. Table 1 also shows the year levels or combination of year levels these teachers were teaching in and the topics that they taught.

Integrating everyday phenomena into physics instructions

Table 2 shows the extent of the use of everyday phenomena in the teaching of the physics teachers. Sixty-five per cent of these teachers provided examples of everyday life phenomena in

their teaching most or all of the time. However, they less often discuss in depth with their students the physics concepts or theories associated with these phenomena. The vast majority of the teachers think that using everyday contexts help students understand physics concepts better and learn physics in a meaningful way (Table 3). Furthermore, being able to see the practical use of physics in their everyday experiences also helps students develop good attitudes towards the study of physics and to a slightly lesser extent to be more creative. A sample of the types of examples used as everyday phenomena, and the manner the teachers integrated them into their teaching is shown in Table 4. There were, however, a substantial number of responses that did not provide direct examples that are drawn from everyday type of experiences. For example, one teacher when teaching about the concept of gravity and free falling bodies, provided as an example 'two bodies with different masses falling with the same accelerations' and no explicit naming of familiar objects was given. Another example of the lack of specific illustrations using real life situations is in the study of forces: the example provided was 'a body moves when applying forces on it'. This demonstrates a possible lack of understanding of what constitutes 'everyday phenomena'.

Table 1. Profile of physics teachers who participated in the research (N= 20)

Descriptions		**Number of teachers**
Gender	Males	10
	Females	10
Teacher qualifications	Bachelor	14
	Masters	6
Type of school	Public school	18
	Private school	2
Years of teaching experience	< 4 years	5
	4-10 years	8
	10-20 years	5
	> 20 years	2
Year level(s) currently teaching	Grade 10	9
	Grade 11	12
	Grade 12	10
Physics topics currently teaching	Mechanics	18
	Heat and Thermodynamics	12
	Electricity and Magnetism	10
	Optics	7
	Nuclear physics	6

Table 2. Teachers' responses to the extent of integration of daily experiences into their physics teaching

Aspects of integration	**All the time**	**Most of the time**	**Sometimes**	**None of the time**	**No response**
Integrate everyday life phenomena in teaching	10%	55%	25%	5%	5%
Discuss relations of physics concepts and the corresponding everyday world	5%	40%	45%	5%	5%
Ask students to relate law and theories of physics with their everyday life experiences	-	40%	60%	-	-

The integration of practical work in physics teaching

As indicated in Table 5, all the teachers participating in this study carry out demonstrations as part of their teaching of physics. The frequency of these demonstrations, however, is low with 80 per cent of the teachers citing that they demonstrate to convey physics principles/concepts less than every fourth session of their teaching time. There are two teachers who use demonstrations to teach physics every lesson.

Table 3. Teachers' responses to the purpose of the integration

Everyday life physics phenomena help students:	Agree	Almost agree	Almost disagree	Disagree	No response
Understand physics concepts better	90%	5%	-	-	5%
Be more creative	65%	15%	-	5%	15%
See the practical use of physics theories in everyday life	65%	25%	-	5%	5%
Have good attitude towards studying physics	65%	20%	10%	-	5%
Learn physics in a meaningful way	50%	45%	-	-	5%

Table 4. Examples of everyday physics phenomena that Vietnamese high school teachers integrate into their physics teaching

Topic	Examples of integrating everyday life physics phenomena	Method of integration
Kinematics	Motions of cars and motorbikes	Observation and explanation
Newton's 3rd law	Why in collision, both two cars are damaged	Explanation and illustration
Surface tension	Why some small insects can walk on water surface	Explanation and experimentation
Conservation of momentum	The gun pulls back when firing	Explanation
Conditions to consider a body is a point	The earth is considered as a point in relative to the Sun	Explanation
Mechanical waves	Propagation of waves	Demonstration
Harmonic oscillator	Oscillation of spring pendulum. Oscillation of tree's branches in windy days	Observation and explanation
Capillary action	Capillary action of oil along a lamp's wick. The height of liquid increases in a capillary tube	Illustration, explanation
Humidity	Fog on grass in a sunny morning	Illustration
Thermal expansion	Solid objects are expanded when heating e.g. the joins of railroad track must have some space to avoid buckling. Thermal automatic turn off device	Illustration Explanation Experimentation
3- phase alternative current	Electricity transmission lines have 3 or 4 wires	Explain (using delta/star methods)
Electrostatics	One object is electrified by rubbing it	Using demonstrations

Table 5. Frequency of use of practical work in physics teaching

		Demonstrations	Practical work
Using experiments in teaching		100%	0%
The frequency of doing experiments	Every session	10%	-
	Every other session	-	-
	Every fourth session	10%	-
	Less than every fourth session	80%	-

Table 6 shows that 75 per cent of the teachers believe that carrying out experiments in the form of demonstrations helps students with their development of conceptual understanding while 50 per cent of them said that they demonstrate because students enjoy the demonstrations. There were three teachers who said that they integrate experiments via demonstrations to help develop students' practical skills. Since none of the teachers engage their students with practical work (see Table 5), it is unclear if these three teachers meant that by watching demonstrations conducted by other people, students are able to develop practical skills, or whether there is actual participation by students in the demonstrations.

As mentioned in the previous paragraph and shown in Table 5, none of these teachers engage their students with practical work at any time. There is no laboratory or experimental work carried out by their students and the major reason, given by 90 per cent of the teachers (see Table 7), is that their schools are not satisfactorily equipped for students to carry out this type of activity. The other main reason for not including practical work in their teaching is the time constraint imposed

on them to get through the curriculum. Other disincentives to carry out practical work with their students are: experiments do not always work, time is needed to prepare for classes (there are no laboratory assistants in schools), and that practical work is not assessed. One teacher said that (s)he has not been trained to teach practical work. However, none thought that it is a waste of time.

Table 6. Teachers' responses to the reasons for integrating experiments in physics instructions

Reasons for integrating experiments	Response
Because students expect it	-
Because students enjoy it	50%
Because it aids conceptual development	75%
To develop practical skills for students	15%
Because doing experiments is compulsory	25%

Table 7. Factors that discourage Vietnamese physics teachers from doing practical work

Discouraging factors	Response
The school is not satisfactorily equipped for experiments	90%
Experiments need time for preparation	25%
The time restriction of the curriculum	55%
Experiments do not always work	35%
Lack of new technologies in school	35%
I haven't trained to teach experiments	5%
Experiments is a waste of time	-
Experiments is not assessed (not compulsory)	25%

Examples of demonstrations carried out by the Vietnamese physics teachers are given in Table 8. For a majority of these teachers, as shown in Table 9, the source of ideas for demonstrations came from personal teaching experiences, teaching training and student text books.

Table 8. Some demonstrations used in physics teaching

Topics	Demonstrations
Thermal expansion	Heating a long metal rod makes it bend
Electric break out in inert gases	Using Comcop machine and tubes containing inert gases at different pressure
Standing waves	Using computer simulation
Acceleration measurement	Measuring the acceleration of a body moving on a slope surface
Projectile motions	Determine the horizontal distance in projectile motions
Harmonic oscillation	Motion of a spring; Oscillation of a pendulum
The interference of light	Young's experiment
Ohm's law	Plot the typical Volt-Ampere line, using voltmeter and ammeter
Newton's first law	An object moving on an air layer; Balance of an object
Magnetic force	Interaction between two magnets, between a magnet and a current, and between two currents
Freely falling body	Drop a paper sheet and a book; Measure the gravity constant
Capillarity	Using capillary tubes; Put a lamp's wick into water
Magnetic field lines	Using a magnet and sprinkling iron
Electromagnetic inductance	Using a magnet and a loop, when magnet moves through the loop, a current appears in the loop
Gravity	Determine the mass of the earth
Dispersion of light	Using a laser, and a prism
Lenses	Formation of the image of an object through a lens
Photoelectric effect	Using a photoelectric cell
The refraction of light	Refraction of light
Forces	Interaction between a magnet with an iron rod; Adding two parallel force vectors

DISCUSSION

This exploratory study seeks to capture the beliefs of a group of physics teachers and their teaching of physics to years 10 to 12 students in Vietnam. The focus of the study has been on the

teachers' use of daily contextual experiences and practical work, including demonstrations, in their teaching. There are two approaches to teaching physics, where teachers could integrate physics concepts to the real world contexts. The more traditional approach would be where concepts are taught first and then related to real life contexts, that is, the application of concepts studied to these situations. In the second approach, the physics concepts are drawn out along the way of the teaching and learning that focus on real world contexts, for example, in using the sun as the context for study, students learn about concepts of heat, light and nuclear reactions. Wilkinson (1999b) argues that the latter approach is superior to the former in terms of the meaningfulness and relevance to learning but that both approaches to teaching and learning of physics are important because both methods link physics concepts to real life contexts, which will motivate and enhance students' interest in science. Karplus (1969) contends that the experiences are important and supports Wilkinson's argument. In this study, the teachers' responses indicate that the first approach is used in their classrooms as none of the open comments obtained from the questionnaires suggested otherwise.

Table 9. The sources of the experiments used in physics teaching

The sources of the experiments	Percentage of teacher using these sources
Initial teacher training	55%
Personal teaching experience	60%
Collective files held in department	20%
Specialised journals	5%
Students text books	55%
Teachers text books	45%
The Internet	5%

The Vietnamese teachers in this study value and see the benefits of the use of contextual approaches in their teaching. This is further supported by open comments such as:

> "Should have regular outdoor activities for students"
>
> "Exams should have some questions relating to everyday life physics phenomena"
>
> "Should integrate more physics phenomena of everyday life into teaching, and the phenomena should be closely focus on topics teaching"
>
> "Should put more physics phenomena in grade 11 physics text book, because there are not many phenomena in the text book"

These views and the views that real life contexts make physics more relevant to learning and will enhance students' interest in physics are similar to those of Australian academics and teachers teaching physics at the senior levels in Victorian schools (Brass, Gunstone and Fensham, 2003; Wilkinson, 1999a). The perception that is dissimilar is that while 95 per cent of the Vietnamese teachers in this study (N=20) thought that drawing in real life contexts will help students with conceptual understanding; only 16 per cent of the Victorian teachers in Wilkinson's (1999a, p.64) study (N=100) thought that this approach helps improve students' understanding. The interpretation of 'context' appears to be varied in both groups of teachers. In the Vietnamese context, the inability of a number of teachers to articulate examples that are deemed real-life suggests that the concept of 'everyday phenomena' and teaching in context is not clear in their minds.

The approach to integrating real-life contexts into physics teaching in the Vietnamese classes is mostly explanations and illustrations by the teachers themselves. Discussion and drawing on students' experiences and prior knowledge do not appear to be evident from both closed and open responses to the questionnaire. A possible inference drawn from this is that the ways of teaching physics are still very much non-constructivist and teacher-centred. The responses of the Vietnamese physics teachers in regards to integrating practical work into their teaching further

support this inference. All the teachers surveyed made use of demonstrations in their teaching but none engage their students in practical work. However, the majority (75%) of the teachers acknowledged the usefulness of practical work in helping students with conceptual development. Six teachers commented openly that doing experiments helps students understand physics concepts better, and develop their practical skills. The constraints with practical work, as shown in Table 6, was reiterated by four teachers that ‘there is a lack of equipment, especially modern equipment’ available for their teaching in this area. Other open comments about the constraints with carrying out practical work in class include:

> “Restriction in time for doing experiments”
>
> “The contents of text books should be changed”
>
> “Teachers do not have enough enthusiasm in doing experiments”
>
> “The curriculum should have more time for experiments”

The responses of the Vietnamese physics teachers in this study indicate that while they value the benefits of laboratory work, the context that they are in does not allow them to reap the benefits.

IMPLICATIONS

While it would not be possible to generalise the findings from the relatively small sample of responses that we have obtained in this study, they provid some insights into the perceptions and concerns of what physics teachers may be holding in Vietnam. The fact that the group of 20 teachers in this study are located in reasonably ‘well-off’ environments, both socially and economically, provides validity to the study. The findings in this study indicate that the type of teaching in Vietnamese high schools is still very traditional and teacher-centred. The lack of students’ active engagement in constructing science knowledge is evident from the data presented in this paper.

In view of the reforms that the Vietnamese government is planning for, it faces huge challenges to successfully meet them. The desire for more student-centred modes of teaching needs to be met with provision of a number of things by the government to assist teachers to engage students actively in the learning and to develop their skills so that they are able to apply what has been learnt to real life situations (see Education law in Introduction section). These things include:

- Money to purchase laboratory equipment and employ laboratory assistants
- Financial support for professional development for teachers in a number of areas:
    - The use of practical work with their students as well as other hands-on ways of engaging students.
    - Teaching in context where students are encouraged to question and develop other cognitive and critical thinking skills.
    - The use of technology such as spreadsheets and simulations in physics teaching.
    - The advantages of action research and how teachers could go about carrying it out.
- Re-designing the content for study at each year level. Based on the three-stage learning cycle of Karplus (1969, 1977), there should be more emphasis on qualitative questions and discussions in the ‘concept introduction’ stage rather than quantitative mathematical-based learning of introductory concepts.
- Re-aligning of assessment tasks to concord with student-centred ways of learning, with the inclusion of assessment of practical work and qualitative-type questions in examinations as possibilities.

Reforms that change teachers' ways of teaching or the rewriting of text books should be based on what research has shown to be effective learning, both at the cognitive and affective levels. There should also be financial assistance to support ongoing research studies that are well conducted at the local levels. There is no quick-fix in any educational reform but carefully planned strategies may be able to bring about some desired changes at an earlier rather than a later time.

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